

TOSVERT VF-A7

Instruction manual with V3 motor

VFA7+Vector option[VEC001Z,003Z] with V3 motor

Toshiba Schneider Inverter Corporation

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- Contents -

1. Comparison with VF-V3 (VFA7+PG feedback).....	2
2. Combination with the motor only for VFV3	7
2.1 Parameter setting.....	8
2.2 Standard connection for VFA7 and V3 motor (1)	10
2.3 Standard connection for VFA7 and V3 motor (2)	11
2.4 Modify of optional cable (RAD320-CA1)	12
2.5 Sensor cable (CAB010) for VEC001Z and V3 motor	13
3. Appendix.....	14
3.1 Setting the rating of the motor.....	14
3.2 Explanation of motor parameter.....	15
3.3 Default setting of motor parameter.....	16
3.4 Accuracy of torque control	17
3.5 Notes on the vector control	18

1. Comparison with VF-V3 (VFA7+PG feedback)

[Specifications, functions]

Series name		TOSVERT-VFA7+PG feedback option	TOSVERT VF-V3
Output capacity		200V: 0.4~90kW 400V: 0.75~280kW	200V: 2.2~55kW
Overload rating		200V: ~55kW, 400V: ~75kW 150%~120sec, 215%~0.5sec 200V 75kW~, 400V: 110kW~ 150%~60sec, 180%~0.3sec	150%~60sec, 200%~2sec (up to 11kW)
Control method		PWM control [Vector control, Digital current control for all range]	PWM control [Vector control, Digital current control for all range]
Control function		Speed/ Torque/ Positioning	Speed/ Torque/ Positioning
Main power supply	200V input class	3ph-200~230V-50/60Hz *only 11~55kW 3ph-200~220V-50Hz 3ph-200~230V-60Hz	3ph- 200~220V-50/60Hz
	400V input class	3ph-380~460V-50/60Hz *only 30~75kW 3ph-380~440V-50Hz 3ph-380~460V-60Hz	-
Rated Speed		60Hz / 1800min ⁻¹ (4 pole) *1	1500min ⁻¹
Maximum motor speed		80Hz / 2400min ⁻¹ (4 pole) *1	2400min ⁻¹
Maximum output frequency		80Hz *2	80Hz
Speed control	Speed control range	1:1000	1:1000
	Speed rate of change	Digital setting: +/-0.01% Analog setting: +/-0.1%	Digital setting: +/-0.01% Analog setting: +/-0.1%
	Speed instruction input	0~+10Vdc / Maximum speed 0~+10Vdc / Maximum speed 4~20mAdc / Maximum speed	0~+/-10Vdc / Maximum speed (Possible to adjust internal setting)
Positioning control	Kind of input pulse	Forward pulse / reverse pulse sequence	Forward pulse / reverse pulse sequence
	Maximum frequency	160kpps	160kpps
	Electronic gear setup	100 ~ 400 ppr / 1 rotation	100 ~ 400 ppr / 1 rotation
Torque control / Torque operation input		0~+/-10Vdc	0~+/-10Vdc

Control function	Acceleration/Deceleration time setting	0.1-6000sec(Straight/ S character)	0.0-60.0sec(Straight/ S character)
	Switching control mode	Possible to switch	Possible to switch
	Preset speed	15 preset speed maximum	3 preset speed
	Braking method	Dynamic brake(resistor) or Re-generating to power supply * Resistor is option devices over 5.5kW * Regenerating converter: SB3 or RC7	Dynamic brake(resistor) or Re-generating to power supply * Resistor is option devices over 22kW * Regenerating converter: SB3 or RC7
	Torque limit(Current limiting function)	Possible to adjust internal setting or external signal. Without temperature compensation	Possible to adjust internal setting or external signal. With temperature compensation
	Speed limit	Electronic gear(for positioning control)	Electronic gear(for positioning control)
	Snap stop control	Enabled to use torque limit function	Enabled
	Trip history monitor	Before the past 4 times	Before the past 8 times
	Applied load GD2	100 or less times of a motor GD2	20 or less times of a motor GD2
	PWM carrier frequency	2.2 ~ 15kHz (200V ~55kW, 400V~75kW) 2.2 ~ 5kHz (200V 75kW~, 400V 110kW~)	up to 11kW: 8kHz fixed over 15kW: 2kHz fixed
Contact output signal	Low speed detection	Low speed detection	Low speed detection
	Reach fixed speed/ finished positioning	Reach fixed speed/ finished positioning	Reach fixed speed/ finished positioning
	Standby	Standby	Standby
	Current limiting	Over torque alarm	Current limiting
	Fault	Fault (All trip code or without EF, OCL trip) [1c relay output, open collector output]	Fault (All trip code) [Open collector output] OFF: Fault ON: Normal
	Fault code	Fault code (2 bit + 4(option) bit)	Fault code(4 bit
	Positioning/ Speed feed back pulse output	Encoder signal with option (A, B phase: 1000ppr, Z phase: 1ppr)	Encoder signal (A, B phase: 1000ppr, Z phase: 1ppr)

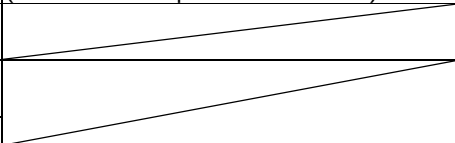
*1 Depends on Motor design and setting of carrier frequency

*2 Possible control up to 120Hz with vector control with specific motor
(Possible control 400Hz with V/f control.)

Series name	TOSVERT-VFA7 + PG feedback option	TOSVERT-VFV3
Analog output	2 output circuit(0-10V) + 2 output by option(+/-10V, 0-20mA) (Select from 31 functions)	2 output(+/-10V) (Speed/ torque or Torque / output current)
Adjust method	6 touch key operation with operation panel	5 touch key operation + 1 reset switch
Monitor	7 segment LED	7 segment LED
Monitoring function	- Frequency of trip - Status - Output frequency - Operation frequency - Output current - DC-bus voltage - Output voltage - Actual output frequency - Speed feedback value(real time) - Speed feedback(1sec filtering) - Torque - Operation torque - Internal torque - Excitation current - PID feedback value - Percentage of motor over load - Percentage of inverter over load - Percentage of PBR over load - Percentage of PBR load - Input power - Output power	- Output current of peek - Out put voltage of peek - Dc-Bus voltage of peek - PG value like motor counter - Positioning pulse - RR input - VI/II input - RX input - RX2 input - FM output - AM output - Fixed output level for meter adjustment - Information of input terminals - Information of output terminals - Switching condition of SINK/SOURCE - Kind of connected optional devices - CPU version - FLASH memory - version - EEPROM1(for control PCB) version - EEPROM2(For drive PCB) version - Trip history 1-4 - Accumulation operation time

Protection	- Over current while acceleration - Over current while deceleration - Over current while constant speed - Over current when starting - U-arm over current - V-arm over current - W-arm over current - Input phase failure - Output phase failure - Over voltage while acceleration - Over voltage while deceleration - Over voltage while constant speed - Over load for inverter - Over load for motor - Over heat - Emergency stop - Failure of EEPROM - PBR over current - PBR over load - Failure of CPU - Failure of communication command - Failure of Gate-array - Failure of SINK/SOURCE switching - Failure of operation keys	- Failure of current detection circuit - Failure of optional devices - Failure of FLASH memory - Low output current - Low input voltage(Main power/ Control power) - Over torque - Earth fault - Failure of DC-Bus fuse - Failure of auto-tuning - Failure of inverter's type-form - Failure of initialize - Failure of RAM - Failure of ROM	- Over Current - Over voltage - Low input voltage - Over load - Over heat/ Failure of regeneration - Failure of sensor - Over speed - Over Position deviation - Motor restraint - Over travel - Failure of parameter setting
Communication	RS485 standard OPTIONAL devices: RS232C, S20, F10M	RS232C, RS485 with Optional device "PCU10(card for positioning)"	
Standard	CE, UL	none	
SINK/ switching	SOURCE Enabled	none	

[Comparison of characteristics]

Series			TOSVERT-VFA7 + PG feedback option			TOSVERT-VFV3		
Control method			Current vector control			Current vector control		
Vector control with sensor			PG feedback (*1), Without temperature sensor			PG feedback with temperature sensor		
Starting torque			0Hz-200% Sensor-less: 0.5Hz-200%			up to 11kW: 0Hz-200% over 15kW: 0Hz-150%		
Zero speed torque	Power running		Enable			Enable		
	Regenerating		Enable (Disable when sensor-less)			Enable		
Speed presumption system			Slip frequency presumption from torque current			Slip frequency presumption from torque current		
Speed control range			1:1000 Sensor-less 1:150 *2			1:1000 (only PG feedback)		
Speed control accuracy (Digital setting)			+/-0.02% *3 Sensor-less +/-0.5% *4			+/-0.01% (only PG feedback)		
Speed response			~ 40 rad/s Sensor-less 15~20rad/s			60rad/s		
PG specifications			- 1000ppr - Line drive system(5V) or Complementary(12V) - 60kHz of maximum input pulse frequency			- 1000oor - Line drive system(5V) - 40kHz(60kHz) of maximum input pulse frequency		
Torque control			Enable without temperature compensation			Enable		
Torque control range (Torque value)			-100~100%			-100~100%		
Speed response while torque control			All range			All range		
Accuracy of torque control			+/-10% (When motor temperature is hot.)			+/-10% (With motor temperature detection)		
Sensor-less control	Speed range of torque control		1:20	1:5	1:2			
	Accuracy of torque	Power running	+/-30%	+/-20%	+/-10%			
		Regenerating	-	+/-30%	+/-20%			
Speed range of torque limit	Power running		All range (Sensor-less 1:20)			All range		
	Regenerating		All range (Sensor-less 1:5)					
Auto-restart			Enable			Enable only speed or torque control		
Regenerative power ride-through control			Enabled			none		

*1 VF-A7: The inverter's capacity is larger than motor's (1 rank-up)

*2 VF-A7: This is over 3.7kW of inverter and motor capacity. (Depends on rated slip frequency)

*3 VF-A7: The base frequency is 60Hz setting.

*4 VF-A7: About 10% of rated slip

2. Combination with the motor only for VFV3

The VF-A7 is possible to operate V3 motor with next optional devices.

[Speed control, Torque control, Positioning control]

Vector control option with sensor (Multi-function): VEC001Z

[Speed control, Torque control]

Vector control option with sensor (Line driver output): VEC003Z

[NOTICE]

- The VF-A7's capacity is larger than V3 motor's. (1 rank or 2 rank-up)
- To install dynamic braking resistor(option) when the machine need large regenerative torque.
It is necessary to install large capacity of resistor in next condition.
 1. Short time cycle of acceleration and deceleration
 2. Large load inertia
- The VEC002Z can't use for V3 motor which PG specifications is line driver output..

[Table of VFA7 and V3 motor combination]

Output capacity (kW)	V3 motor's type-form	Case number	VFA7 specifications	VFV3 specifications
2.2	IK-EBKM8-VFV3	100L	VFA7-2037PL	VFA7-2055PL
3.7	IK-EBKM8-VFV3	112M	VFA7-2055PL	VFA7-2075PL
5.5	IKK-EBKM8-VFV3	132S	VFA7-2075PL	VFA7-2110P
7.5	IKK-EBKM8-VFV3	132M	VFA7-2110P	VFA7-2150P
11	IKK-EBKM8-VFV3	160M	VFA7-2150P	VFA7-2185P
15	IKK-EBKM8-VFV3	160L	VFA7-2185P	VFA7-2220P
22	TIK-EBKM8-VFV3	180M	VFA7-2300P	VFA7-2370P1
30	TIK-EBKM8-VFV3	180L	VFA7-2370P1	VFA7-2450P1
37	TIK-EBKM8-VFV3	200L	VFA7-2450P1 *2	VFA7-2550P1
45	TIK-EBKM8-VFV3	200L	VFA7-2550P1 *2	VFA7-2750P1
55	TIK-EBKM8-VFV3	225S	VFA7-2750P1	VFA7-2900P1

*1 The type-form of V3 motor is Leg attachment type.

*2 Load reduction may be needed.

VFA7 specifications:

Overload rating: 150%-2min, 215%-0.5sec

VFV3 specifications:

Overload rating: 150%-2min, 215%-0.5sec

The starting torque is 200%~300%.

2.1 Parameter setting

To use VFA7 with V3 motor, these parameter setting are needed.

* It is necessary to set others parameter for torque control or positioning control

Title	Function	Setting range	Setting value
vL	Base frequency	25.0 – 400.0 Hz	52
Pt	Selection of V/f control	0 – 9	8 or 9
OLM	Selection of electric thermal characteristics	0 – 7	4
F240	Starting frequency	0.0 – 10.0 Hz	0.0
F304	Selection of Dynamic brake	0: Disabled , 1: Enabled	1 *1
F306	Base frequency voltage 1	0 – 600 V	160
F307	Selection of base frequency voltage	0: Without power supply voltage compensation Without output voltage limit 1: With power supply voltage compensation Without output voltage limit 2: Without power supply voltage compensation With output voltage limit 3: With power supply voltage compensation With output voltage limit	1
F308	PBR value	1.0 – 1000 ohm	Depends on capacity *1
F309	PBR capacity	0.01 – 600 kW	Depends on capacity *1
F367	Pulse number of PG input	1 – 9999	1000
F400	Selection of auto-tuning	0 – 2	1 (Initialize of motor parameter)
F412	Motor rated capacity	0.10 – [depends on capacity]	*2
F413	Motor type	0 – 4	2 (V3 motor)
F606	OL reduction starting frequency	0.0 – 30.0 Hz	0.0

*1 It is necessary to set when use braking resistor.

*2 Set the using V3 motor's rated capacity.

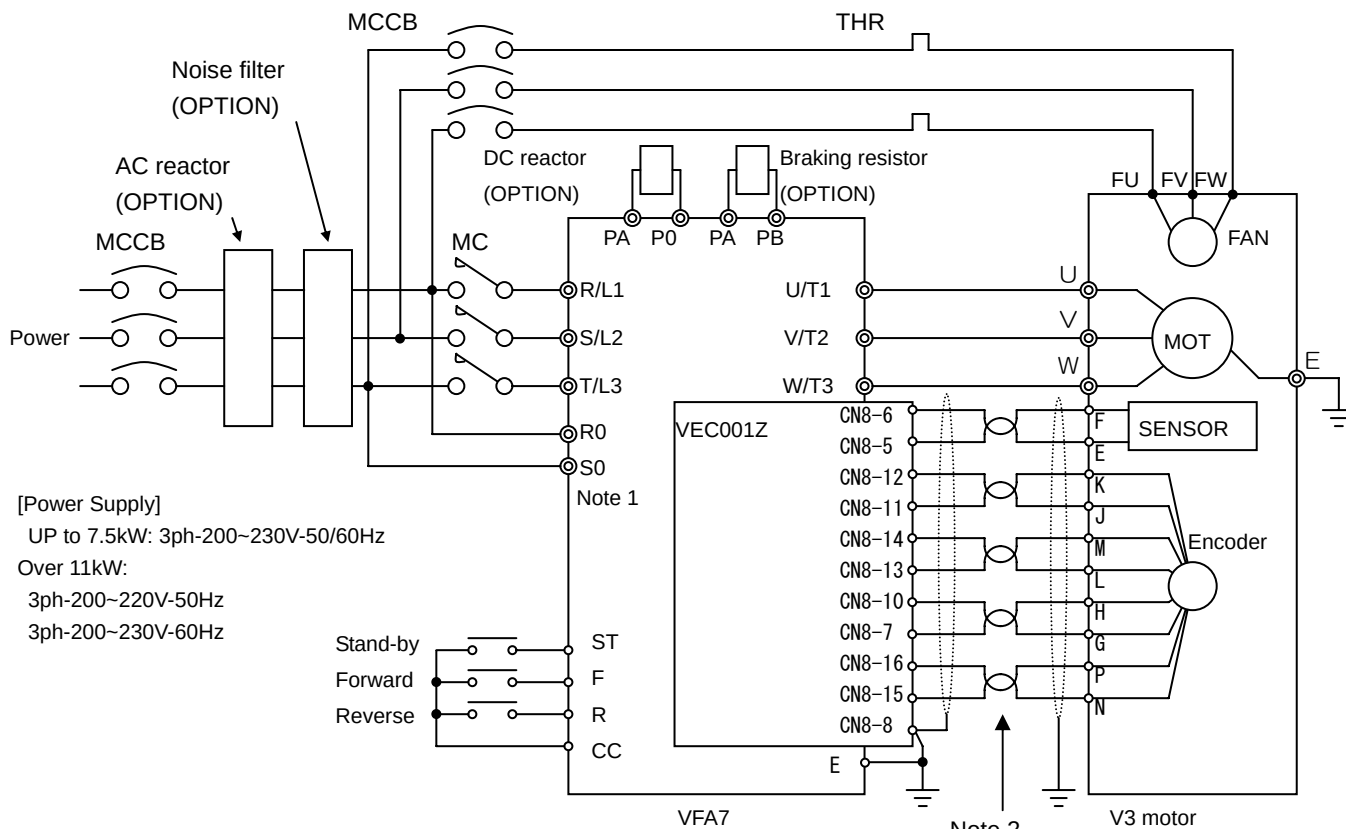
Parameters of individual adjustment

Title	Function	NOTE
F374	Current control proportional gain	It is necessary to adjust torque response in torque control mode. * Usually, not to change (default setting)
F375	Current control integral gain	
F376	Speed loop proportional gain	Depends on inverter's capacity and load inertia. Please adjust next formula. $F376 = (50 + A * PW) * J^{0.12}$ A: Coefficient of motor pole (2 pole: 1.8, 4 pole: 2.0, 6 pole: 2.2) PW: Inverter's capacity (ex. VFA7-2037PL: PW=3.7) J: Load inertia / Toshiba standard motor's inertia (ex. 4 times of inertia: J=4)
F377	Speed loop integral gain	Usually, not to change (default setting).

2.2 Standard connection for VFA7 and V3 motor (1)

This connection diagram is for VFA7 and VEC001Z(Vector control option with sensor).

When you select torque control or positioning control, it is necessary to wire others connection.



[Table of wiring for V3 motor's sensor cable]

CN8	Canon plug	Wire color(*)	V3 signal name	CN8 terminal's signal name	CN8	Canon plug	Wire color(*)	V3 signal name	V3 signal name
1	A	BW	-	PGA1	9	-	-	-	VD
2	B	BW/WT	-	PGA2	10	H	BL	Z	Z
3	C	RD	-	PGB1	11	J	YL	NA	NA
4	D	RD/WT	-	PGB2	12	K	BL/WT	A	A
5	E	OG	MT	PGZ1	13	L	GR	NB	NB
6	F	OG/WT	MT	PGZ2	14	M	GR/WT	B	B
7	G	BL/WT	NZ	NZ	15	N	GY	COM	PGCC
8	-	-	SHLD	E terminal	16	P	GL/WT	P5	PGVC

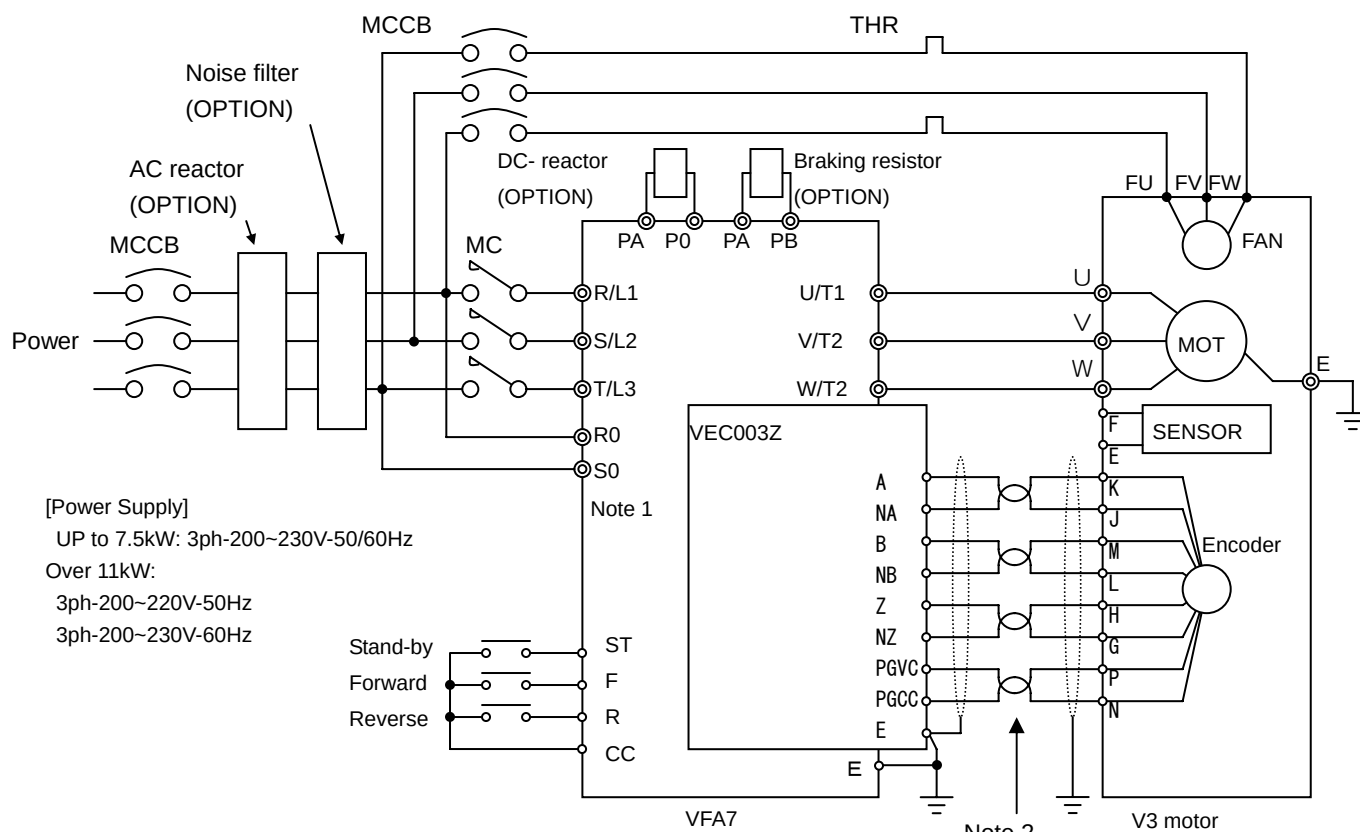
BW: Brown, WT: White, RD: Red, OG: Orange, BL: Blue, YL: Yellow, GR: Green, GY: Gray

* There are case of different from wiring color.

2.3 Standard connection for VFA7 and V3 motor (2)

This connection diagram is for VFA7 and VEC003 (Vector control option with sensor).

When you select torque control or positioning control, it is necessary to wire others connection.



[Table of modify for V3 motor's sensor cable]

CN8	Canon plug	Wiring color	Signal name	NOTE	CN8	Canon plug	Wiring color	Signal name	NOTE
1	A	BW	-	not to use	9	-	-	-	not to use
2	B	BW/WT	-	not to use	10	H	BL	Z	Connect to Z
3	C	RD	-	not to use	11	J	YL	NA	Connect to NA
4	D	RD/WT	-	not to use	12	K	YL/WT	A	Connect to A
5	E	OR	MT	not to use	13	L	GR	NB	Connect to NB
6	F	OR/WT	MT	not to use	14	M	GR/WT	B	Connect to B
7	G	BL/WT	NZ	Connect to NZ	15	N	GY	COM	Connect to PGCC
8	-	-	SHLD	Connect to E	16	P	GY/WT	P5	Connect to PGVC

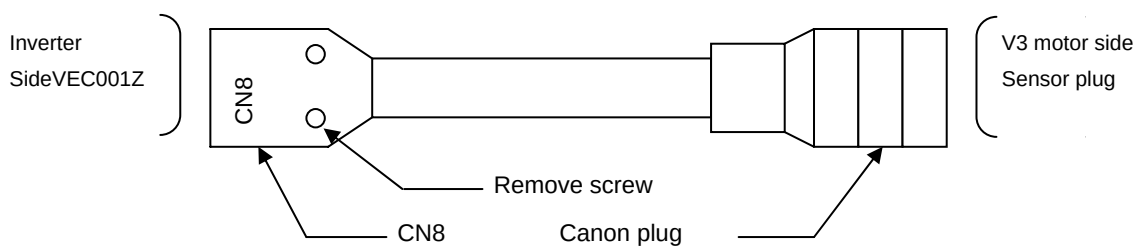
BW: Brown, WT: White, RD: Red, OG: Orange, BL: Blue, YL: Yellow, GR: Green, GY: Gray

* There are case of different from wiring color.

2.4 Modify of optional cable (RAD320-CA1)

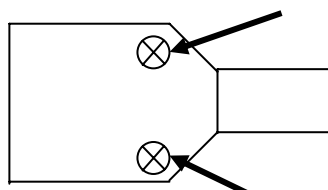
When using sensor cable "RAD320-CA1" for VF-V3 made by Toshiba Industrial Products Manufacturing Corporation, cut the shield of CN8-8pin side and connect to ground(E terminal).

In case of using CAB010 (OPTION), this modify don't need.

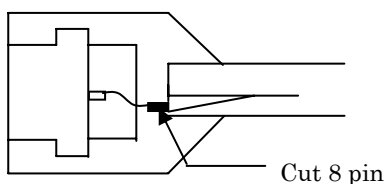


RAD320-CA1 modify method

1. Remove screw of CN8



2. Cut 8 pin(SHLD)

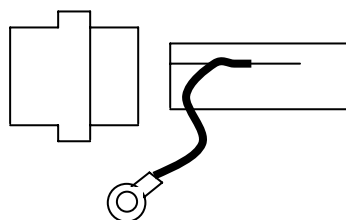


CN8 connector-pin assignment

11	12	13	14	15	16
A	A	B	B	COM	P5
7	8	9	10		
Z	SHLD		X		
1	2	3	4	5	6
				MT	MT

View: Soldering side of connector

3. Connect 8-pin(shield line)ground/earth terminal of VEC001Z.

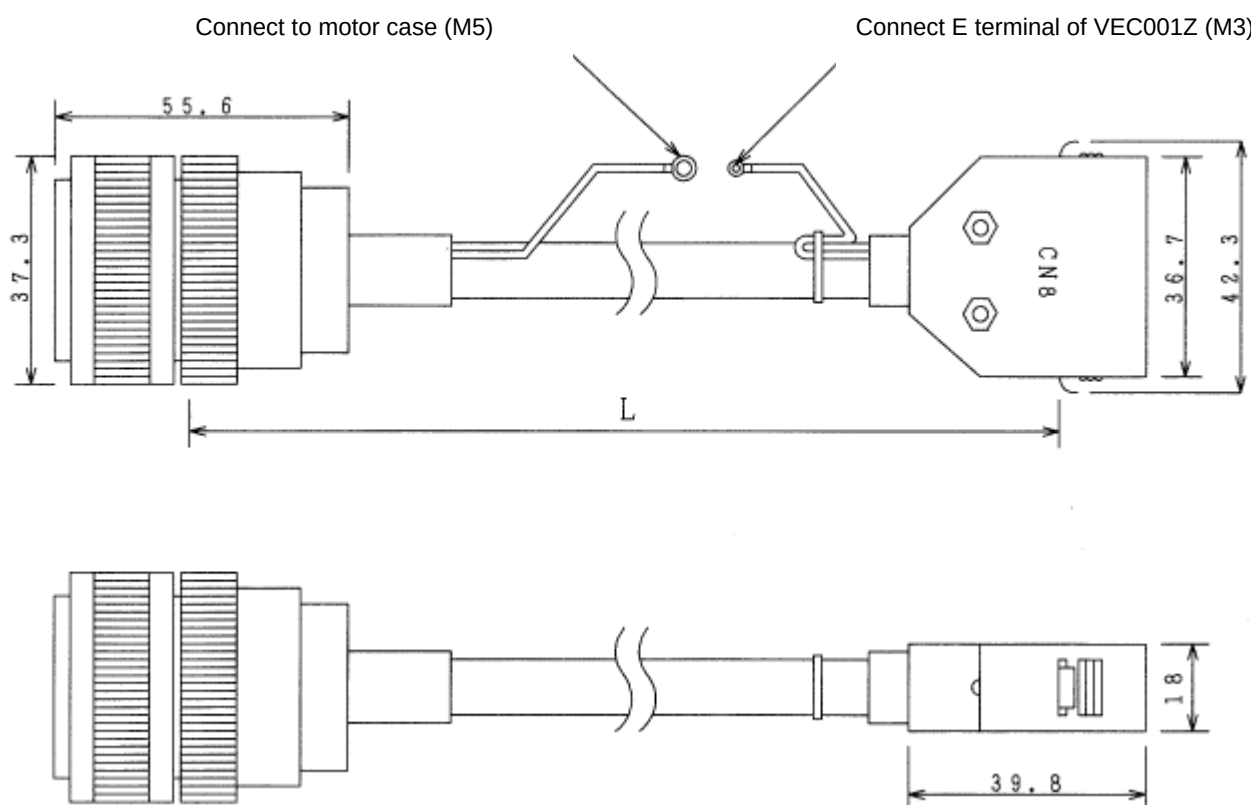


4. Repair CN8 after taping (insulation)

2.5 Sensor cable (CAB010) for VEC001Z and V3 motor

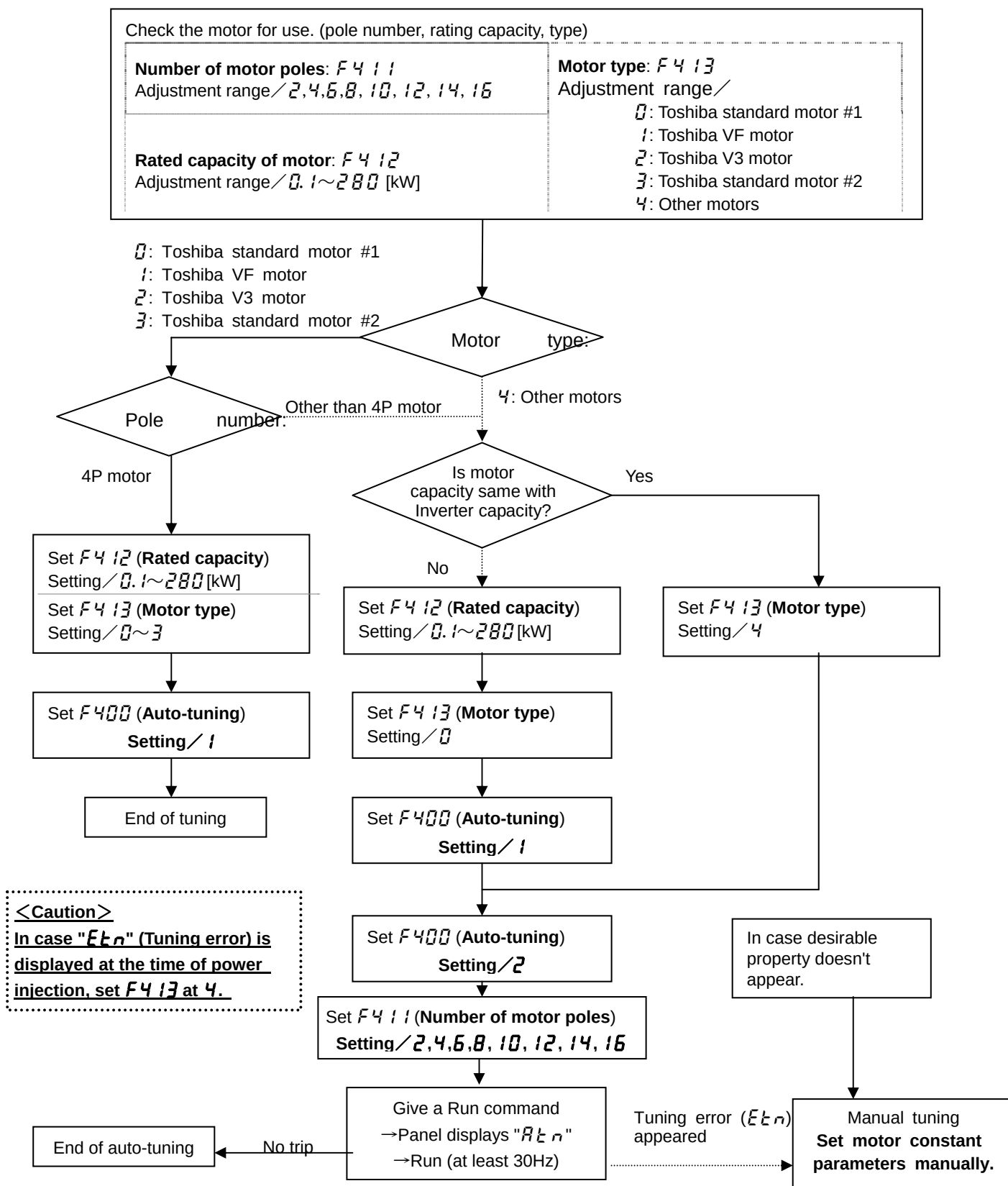
The CAB010 has three variety for cable length.

Type-Form	Cable length(L)
CAB010-10M	10m
CAB010-20M	20m
CAB010-30M	30m



3. Appendix

3.1 Setting the rating of the motor



3.2 Explanation of motor parameter

This section describes how to set motor constants. Select the items to be improved and change the related motor constants.

1. Slip frequency gain *F401*

This parameter is to adjust the slippage of the motor.

Setting this parameter at a larger number can reduce the slippage of the motor. However, setting it at an excessively large number may result in hunting, etc., and thus cause an unstable operation.

2. Motor constant #1 *F402* (Primary resistance) (Motor test reports may be useful.)

This parameter is to adjust the primary resistance of the motor.

Setting this parameter at a larger value can prevent the drop of the motor torque in low speed ranges due to a voltage drop. However, setting it at an excessively large number may result in large current in low speed range and appearance of overload trip, etc..

3. Motor constant #2 *F403* (Secondary resistance)

This parameter is to adjust the secondary resistance of the motor.

The larger the set value, the more the slippage of the motor can be compensated.

4. Motor constant #3 *F404* (Exciting inductance)

(A motor test record can be used for this setting.)

This parameter is to adjust the exciting inductance of the motor.

The larger the set value, the more the no-load current can be decreased.

5. Motor constant #4 *F405* (Load inertia moment)

This parameter is to adjust the transient response of the motor.

Setting this parameter at a larger value can reduce overshooting on completion of acceleration or deceleration. Set this parameter at a value, which matches to the effective moment of inertial.

6. Motor constant #5 *F410* (Leak inductance) (Motor test reports may be useful.)

This parameter is to adjust the leakage inductance of the motor.

The larger the set value, the larger torque the motor can be produced in high-speed ranges.

3.3 Default setting of motor parameter

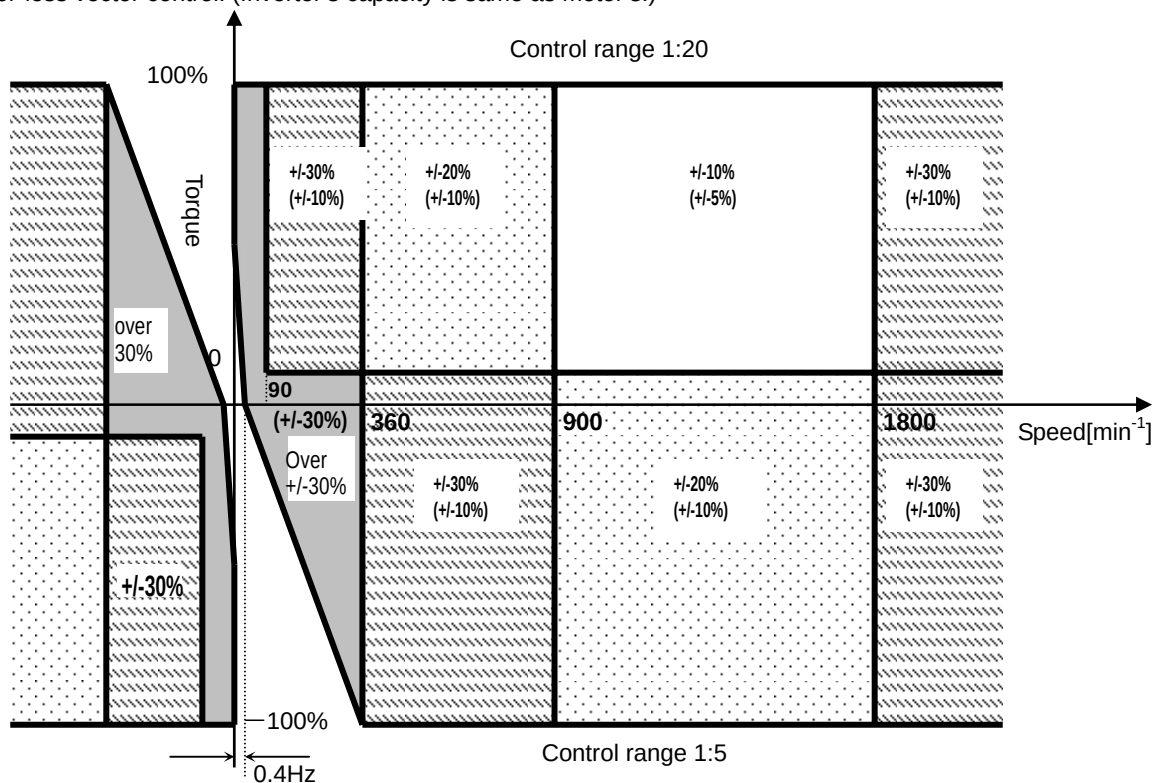
Inverter model	Motor constant #1 (primary resistance)	Motor constant #2 (secondary resistance)	Motor constant #3 (exciting inductance)	Motor constant #5 (leak inductance)
	<i>F402</i>	<i>F403</i>	<i>F404</i>	<i>F410</i>
VFA7-2004PL	63.12	3648	253.1	23.61
VFA7-2007PL	3453	1841	159.5	13.34
VFA7-2015PL	1394	825.2	107.5	7.90
VFA7-2022PL	943.7	574.7	89.0	6.01
VFA7-2037PL	501.2	330.2	66.2	3.87
VFA7-2055PL	258.6	131.6	46.5	3.23
VFA7-2075PL	176.2	105.9	39.4	2.62
VFA7-2110P	107.6	62.20	29.5	2.04
VFA7-2150P	69.34	53.30	22.0	1.39
VFA7-2185P	56.92	39.20	17.0	1.24
VFA7-2220P	44.28	36.80	15.5	1.05
VFA7-2300P	34.04	30.50	11.7	0.79
VFA7-2370P1	24.38	30.20	9.9	0.66
VFA7-2450P1	18.28	22.90	7.8	0.51
VFA7-2550P1	13.22	12.40	6.1	0.38
VFA7-2750P1	10.35	12.20	6.2	0.36
VFA7-2900P1	7.48	9.30	4.8	0.29
VFA7-4007PL	1381(*1)	7365	638.1	53.36
VFA7-4015PL	5578	3301	429.9	31.60
VFA7-4022PL	3775	2299	356.2	24.04
VFA7-4037PL	2005	1321	264.6	15.49
VFA7-4055PL	1035	526.4	186.2	12.91
VFA7-4075PL	704.7	423.6	157.7	10.48
VFA7-4110PL	430.6	248.8	117.8	8.16
VFA7-4150PL	277.4	213.2	88.1	5.54
VFA7-4185P	227.9	156.9	70.4	4.96
VFA7-4220P	176.9	147.0	62.1	4.20
VFA7-4300P	135.9	122.1	46.8	3.16
VFA7-4370P1	97.52	120.7	39.8	2.65
VFA7-4450P1	73.26	91.60	31.3	2.03
VFA7-4550P1	52.78	49.50	24.4	1.52
VFA7-4750P1	41.63	48.60	24.7	1.43
VFA7-4110KP1	20.47	32.20	14.9	1.02
VFA7-4132KP1	12.42	22.80	11.8	0.80
VFA7-4160KP1	9.43	7.80	8.9	0.59
VFA7-4220KP1	5.98	8.80	7.2	0.45
VFA7-4280KP1	4.83	4.30	6.8	0.34

(*1): *1381* and *E1* blink alternately because the setting value is larger than 10ohm(10000mohm).

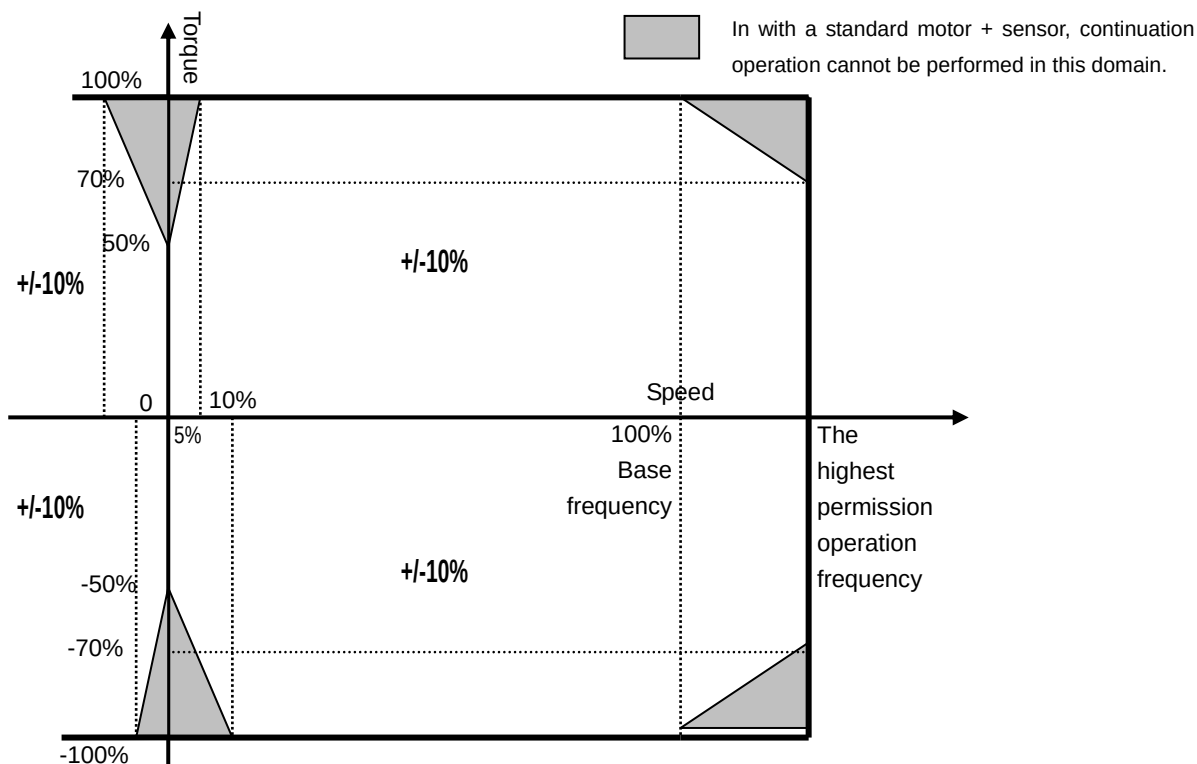
(*2): For each inverter model, *F412*'s upper limit is rated capacity of one rank larger inverter. (Example: For the model VFA7-2004PL, the upper limit is 0.75)

3.4 Accuracy of torque control

- Sensor-less vector control. (Inverter's capacity is same as motor's.)



- Vector control with sensor. (Inverter's capacity is same as motor's.)



3.5 Notes on the vector control

- 1) The vector control fully exerts its effect in frequency ranges below the base frequency (f_L) and its effect is reduced in frequency ranges above the base frequency.
- 2) Set the base frequency between 40 and 120 Hz when selecting a sensor-less vector control mode ($Pt = 2 \sim 5, 7$), or between 25 and 120 Hz when selecting a sensor vector control mode ($Pt = 8, 9$).
- 3) Use a general-purpose or squirrel-cage motor with the same rating as the inverter, or smaller by one rank.
This inverter cannot be used for motors with capacities of less than 0.4 kW. If the VFA7-2004PL is combined with a 0.2 kW motor, an auto-tuning error ($E \neq n$) may arise, and thus disable the vector control.
- 4) Use a motor with 2 to 16 poles.
- 5) Use the inverter for a single motor at a time. This inverter is incapable of vector -controlling more than one motor simultaneously.
- 6) Do not use wires longer than 30 m for the connection between the inverter and the motor. When using wires longer than 30 m, select a normal auto-tuning mode to improve the low-speed torque characteristics in vector control mode. In this case, the torque produced by the motor decreases more or less around the rated frequency because of a voltage drop.
- 7) If a reactor or surge suppressing filter is connected between the inverter and the motor, the torque produced by the motor may decrease or the inverter may trip ($E \neq n$) in auto-tuning mode, and therefore the vector control can not be used.
- 8) Connect speed sensor for vector control with sensor to the motor. Connecting via gear, etc. causes motor's oscillating or inverter's trip by lack of rigidity.